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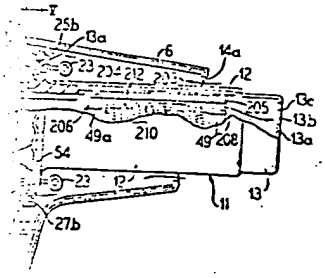

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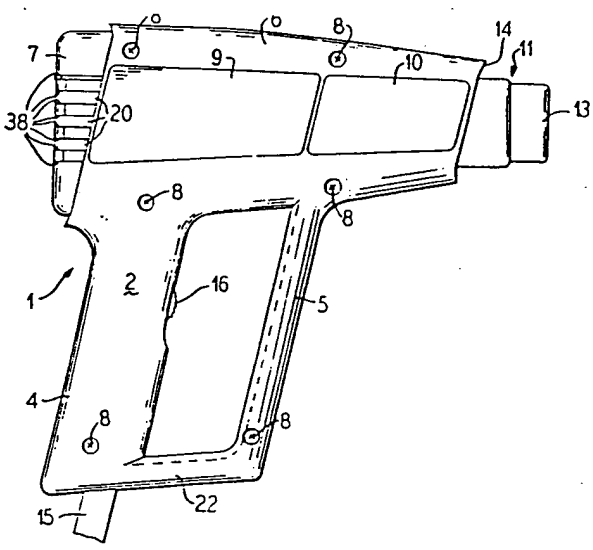
(54) **Hand held hot air blower.**

(57) A hot air gun or blower of the type useable for blistering paint on a painted surface for easing the removal of paint thereof has a housing (2, 3) with internal brackets (24a-b, 25a-e, 26a-c, 27a-e, 28a-e, 30a-c, 31a-e, 50a-b) supporting and retaining a switch assembly (36), a circuit board (51), a motor (69) having an impeller (40), a motor mount (101), a shroud (41) surrounding the impeller (40), and a heating element (11). The internal brackets supporting these elements are configured so as to provide a number of air passages (60, 61a-b, 62a-b, 63) between the elements and the interior wall of the housing. In addition to drawing air through a rear portion of the gun, air is drawn through an annular opening (14a) in the front of the gun between the cover (12) for the heating element (11) and the housing (2, 3). The air thus passes over the covered heating coil (212) and is preheated before being blown by the impeller (40) directly over the coil (212) for primary heating. At least one wave-like flange (53) is received between spaced interior brackets (26a-b) in the housing for providing a press fit of the components between the two housing halves (2, 3) thus eliminating the need for mechanical fasteners for mounting the components of the gun.



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HAND HELD HOT AIR BLOWER

DESCRIPTION

Many types of hand-held hot air blower devices are known in the art which direct a flow of heated air at an object. Devices of this type which are specifically designed for the purpose of but not limited to directing heat at a painted surface, thereby causing the paint to blister to facilitate the subsequent removal thereof from the surface are described, for example, in United States patents 1,995,240; 2,481,760; 2,577,269; 3,094,606; 3,109,083 and 3,115,567.

Such conventional units, in order to achieve the necessary high temperature elevation and required volume of air movement, are cumbersome and generally employ a considerable number of cooperating components, many of which are prone to failure over continued use. Units, of the type such as hand-held hair dryers, sacrifice high temperature elevation and add high volume of air handling in order to achieve the smaller, more manageable size without overheating of inexpensive components. Such units are generally not acceptable for paint removal purposes because those devices cannot attain the necessary air temperature required to effectively blister the paint.

Additionally, various shapes of impellers or fan blades are known in the art for generating an air flow by rotation thereof by means of a motor. Such impellers, regardless of shape, unavoidably impart turbulence and other fluid disturbances to the air by virtue of moving the air at a rapid rate. Such turbulence reduces the smooth flow of air through the remainder of the device thus requiring more work to move a given volume of air through the device and slowing the velocity of air passed a given point in the device. Moreover, if the air moved by the impeller is to be subsequentally treated, such as by heating, such treatment may be disturbed or impaired by such high turbulence, and the heating itself may contribute to uneven pressures affecting air flow.

Many blowers are thus provided with vanes and other elements for acting upon the air flow generated by an impeller or fan in an attempt to "straighten" the air flow. One such device is described, for example, in USLP 4,039,774 which makes use of a cone having a plurality of curved veins thereon, the cone being received in a complimentary-shaped cover, in which a heater assembly is disposed for heating the moving air.

Heating coil assemblies are known in the art for use in various types of hot air blowing devices, such as paint-removing blowers, hair dryers and the like. Conventional heating coil assemblies are generally positioned adjacent to a blower fan and have a resistance heating element, generally in the form of a coil wire, disposed such that the blower moves air to be heated axially over the coil, such that when the air exits the assembly it has been elevated in temperature by the coil.

Many conventional units simply have the coil, and supporting means therefor, disposed openly within the housing of the blower device, such that the air passage surrounding the coil is a relatively large volume defined by the coil itself and the interior wall of the housing. Examples of such conventional devices are described in United States patents 3,943,329; 3,947,659; 3,109,083; 2,778,919; 2,730,609; 2,041,687; 1,955,240; 1,821,525 and 1,777,744.

Other known heating coil assemblies have a sleeve or other interior means surrounding the coil in the inside of the device housing, so as to define a smaller volume for passage of air over the coils. Examples of devices of this type are described in United States patents 4,198,556; 3,857,016; 3,668,370; 3,612,824 and 3,094,606.

A problem existing in the field of heating coil assembly manufacture is that of providing a reliable heating means which can be utilized for purposes requiring a sufficient volume of extremely hot air, such as for removing paint from a surface by causing the paint

to blister by the application of intense heat thereto, is that of providing a heating element which meets these demands which is inexpensive, easy to assemble, and has relatively few elements. A further problem in the design and manufacture of such heavy duty heating elements is to provide such an element which generates sufficient heat for elevating the temperature of a large volume of air but which is sufficiently insulated from the remainder of the device so as to not cause a danger to the user.

It is an object of the present invention to provide a hand-held hot air gun for but not limited to directing a flow of heated air at a painted surface for blistering the paint and thereby easing removal thereof from the surface which is lightweight, easily manageable, and has a simplified construction contributing to a longer useful life without failure.

It is a further object of the present invention to provide such a hot air gun which has a number of components retained in a housing with as few mechanical fastening means as possible.

Another object of the present invention is to provide such a hot air gun which promotes efficient operation by preheating air drawn into the unit before the air is directed over a heating means for primary heating. The air drawn in the front of the unit also substantially reduces the temperature of outside case; this allows us to pass U.L. temperature requirement with lower cost plastics and supplies more operator comfort.

A further object of the present invention is to provide such a hot air gun having a "clam shell" housing assembly consisting of two halves, each housing half having a number of brackets for supporting the interior components, which brackets simultaneously form a number of air passages in combination with the supported components.

It is another object of the present invention to provide an impeller and shroud assembly for a blower device which operate in combination to provide an essentially uniform, low-turbulent air flow.

It is an object of the present invention to provide a heating coil assembly for use in a heavy duty hot air blowing device which consists of a small number of elements which are easily assembled and retained.

A further object of the present invention is to provide a means for assemblying the heating coil assembly which simultaneously axially and radially positions and retains the elements thereof.

Another object of the present invention is to provide such a heating coil assembly which rapidly and effectively elevates the temperature of a high volume of moving air yet provides sufficient insulation from surrounding components so as to minimize heat transfer thereto, thereby contributing to safer operation of the device containing the assembly.

The above objects are inventively achieved in a hot air gun having a housing consisting of two joined mirror-image halves, each of which has a plurality of brackets therein for supporting components such as a switch assembly, a circuit board, a motor with an impeller, a motor mount, a shroud surrounding the impeller and a heater unit, within the housing. The motor, motor mount, shroud and heater unit are retained in the brackets so as to form a continuous assembly. The brackets for supporting this assembly are formed in spaced pairs, with adjacent flanges of the respective units being received between the brackets, and being retained therein when the two halves of the housing are joined and held together by suitable fasteners.

In order to provide a tight press fit, the flange may be made wave-like along a portion of the circumference to increase flange thickness to exert pressure between the brackets to maintain the adjacency of the flanges received between the brackets, as well a tightly

retaining the entire assembly so that no rattle or other vibration-induced noise results during operation of the air gun.

The brackets are arranged within the housing with radial spaces therebetween so as to provide a plurality of air inlet passages in cooperation with the interior housing wall and the exterior walls of the various components. The housing for the gun has a plurality of air inlet openings at a rear thereof through which air is drawn by the action of the motor-driven impeller, and which is subsequently blown across a resistance coil of the heater unit. Additionally, the gun has an annular air inlet opening at a front portion thereof surrounding the metal casing of the heater unit. Air is also drawn through this opening and is thus preheated by the heat dissipated through the metal casing and case halves. This air is further drawn by the action of the impeller through the passages formed by the support brackets in the housing to a rear of the impeller, and the preheated air is thus directed with the unheated inlet air over the coil for primary heating thereof.

The hot air blower further includes an assembly having an impeller with a plurality of curved blades radially extending therefrom which is rotated by a motor for moving air through a blower device. The impeller is completely surrounded by an annular shroud having a plurality of air passages therein, also extending radially from a center of the shroud; the passages being curved substantially the same as the impeller blades. The air moved by the impeller blades must pass through the passages before entering the remainder of the blower device. The passages accept substantially only air which is already moving in the direction defined by the curve of the impeller blades, and the curve of the openings, thereby generating a uniform, substantially smooth air flow through the remainder of the blower device.

The hot air blower also has a heating coil assembly having an annular mounting element, which may be comprised of plastic, and two ceramic end faces with a ceramic core about which a resistance heating element is spirally wound and a ceramic sleeve disposed therebetween. Each element has a polygonal (i.e., rotation preventing) centrally disposed bore therein for receiving a heavy gauge polygonal wire retainer therethrough. The retainer is swaged at one end and is fitted with a press fit washer at its opposite end for simultaneously axially and radially positioning and retaining all of the elements, and further facilitating ease of assembly of the elements.

Each of the end faces which are disposed adjacent the insulating sleeve surrounding the heating element have veins extending toward the interior of the sleeve which are received in the sleeve so as to form in combination a cylindrical insulating shield for the heating element.

ON THE DRAWINGS

Figure 1 is a side elevational view of a hot air gun constructed in accordance with the principles of the present invention.

Figure 2 is a front elevational view of the hot air gun shown in Figure 1.

Figure 3 is a side elevational view, partly in section, of the hot air gun shown in Figure 1 with one-half of the housing removed exposing the interior components.

Figure 4 is a sectional view of the hot air gun shown in Figure 3 taken along line IV-IV.

Figure 5 is a sectional view of the hot air gun shown in Figure 3 taken along line V-V.

Figure 6 is a side elevational view of one-half of the housing shown in Figure 3 with the interior components removed therefrom.

Figure 7 is a sectional view of a portion of the housing shown in Figure 6 taken along line VII-VII.

Figure 8 is a sectional view of a portion of the housing shown in Figure 6 taken along line VIII-VIII.

Figure 9 is a sectional view of a portion of the housing shown in Figure 5 taken along line IX-IX.

Figure 10 is a sectional view of the portion of the housing shown in Figure 9 taken along line X-X.

Figure 11 is a sectional view of an impeller and shroud assembly constructed in accordance with the principles of the present invention.

Figure 12 is a sectional view taken along line II-II of Fig. 11.

Figure 13 is an end view of the motor mount employed in the assembly shown in Fig. 11.

Figure 14 is a circuit diagram for the heating coil in the assembly shown in the following figures.

Figure 15 is a sectional view of a heating coil assembly constructed in accordance with the principles of the present invention.

Figure 16 is an end view of the heating coil assembly shown in Figure 15.

Figure 17 is an exploded perspective view of the heating coil assembly shown in Figure 15.

A hand-held hot air gun constructed in accordance with the principles of the present invention is shown in exterior side and front elevational views in Figures 1 and 2. The gun 1 has a housing comprised of two housing shells 2 and 3. When joined, the shells 2 and 3 provide a pistol grip 4, a guard 5 joined to the grip 4 by a connector 22, and a barrel portion 6. The shells 2 and 3 further form an air inlet baffle 7 having a plurality of rearward air inlets 38, described in greater detail below. The shells 2 and 3 are held together by a plurality of fasteners 8, such as screws. The exterior of the barrel portion 6 may have indentations 9 and 10 for receiving manufacturer's labels, warnings, and the like. The shells 2 and 3 may consist, for example, of plastic.

The housing formed by the joined shells 2 and 3 contains a heater unit 11, having an exterior metal casing 13, a portion of which projects from an opening 14 at the front of the gun 1. As shown in Figure 6, the opening 14 is formed by a rim 14a of each of the shells 2 and 3. The front of the casing 13, as best seen in Figure 2, has a guard to prevent most objects from coming into contact with the heating coil disposed inside the casing 13. The guard is in the form of a centrally disposed hub 13a having a plurality of radially extending strusts 13b joining the hub 13a to the casing 13. A plurality of radial apertures 13c are thus formed between the struts 13b for permitting outward flow of heated air.

The gun 1 has an actuator 16 which is part of a switch assembly 36 (shown in Figure 3) received in the housing formed by the shells 2 and 3. The actuator 16 projects to the exterior of the gun 1 through an elongated opening 4a formed by the shells 2 and 3, and is slideable therein to turn the motor operating the gun 1 on and off, and to operate the motor at different speeds and the heater at lower wattage and temperature ranges. A heavy duty electrical cord 15 is received within the housing formed by the shells 2 and 3 for supplying power to the gun 1.

As best seen in Figure 8, the two shells 2 and 3 are joined by a tongue-and-groove arrangement. A tongue 18 is carried at the perimeter of the shell 3 and a complementary shaped groove 19 is carried along the corresponding perimeter of the shell 2. When the tongue 18 is received in the groove 19, an interior seam 17 and an exterior recess 17a are formed. The recess 17a facilitates prying apart of the shells 2 and 3 if necessary, after removal of the fasteners 8 and approves appearance.

As shown in Figure 3, the gun 1 contains a number of internally disposed components which are mounted in the shells 2 and 3. It will be understood that the shells

2 and 3 are essentially mirror images, and therefor in Figure 3 components are only shown received in the shell 3, and in Figure 6 only the details of the shell 3 are shown. The main components received and retained in the shells 2 and 3 are the aforementioned switch assembly 36, a circuit board 51, a motor 69 having an impeller 40, a motor mount 42, a shroud 41 surrounding the impeller 40, and the aforementioned heater unit 11. Further details of the cooperation among and mounting of these components are described below. The switch assembly 36 is received in spaced brackets 24a and 24b (shown in Figure 6) in the housing shell 3. The switch assembly 36 is connected via leads 37 in a standard manner to the exterior power cord 15. The exterior power cord 15 terminates in a flanged collar 35 which is received in an annular retainer 33 formed in the shell 3. The posts 34 may be provided if the cord is to be equipped with a strain relief in addition to a molded cord set relief.

The switch assembly 36 has further leads 37a connected to the circuit board 51 in a standard manner. The circuit board 51 includes rectifying components and other circuitry necessary for operating the motor 69 and providing two heat output settings, the details of which are well known to those skilled in the art, and therefore the specific wiring need not be described in greater detail. The circuit board 51 is retained in spaced brackets 50a and 50b formed in the shell 3.

The motor mount 42 has a plurality of radial fins 43 which in combination form an annular receptacle, as best seen in Figure 4, for receiving the motor 69. The motor 69 is held therein by suitable fasteners 64, such as screws. As stated above, the motor 69 has a shaft 39 on which an impeller 40 having a plurality of radially extending impeller vanes is mounted. The impeller 40 is rapidly rotated by the motor 69.

The impeller 40 is surrounded by a shroud 41 disposed adjacent to the motor mount 42. The shroud 41 collects and directs air moved by the impeller 40 and communicates with the heater unit 11 for transporting the air moved by the impeller 40 over a resistance heating coil 44 in the heater unit 11. The heater unit 11 has a plastic annular connector 52 which receives the shroud 41. The connector 52 is disposed adjacent a ceramic end cap 46 having a plurality of radial vanes 48 extending from a central hub 49 so as to provide a plurality of radial apertures therebetween for permitting air flow therethrough. The end cap 46 is adjacent a hollow cylindrical ceramic sleeve 45 which is closed at its opposite end by another identical end cap 46, also having apertures therein for permitting air flow therethrough, so as to provide a ceramic shell for the resistance heater coil 44. The coil 44 is helically wound on a ceramic core disposed within the ceramic shell. An insulating sleeve 12 is disposed between the ceramic shell and the metal casing 13. As best seen in Figure 5, the connector 52 has an interior rim 55 from which a plurality of struts 56 radially inwardly project and join a central hub 58. The hub 58 as well as the end caps 46 and the ceramic core about which the coil 44 is wound each have a central square bore therein for receiving a square retainer 59 which fixes the relative radial positions of those components. A plurality of leads 60 for supplying current to the coil 44 are guided by the connector 52 and are connected to the circuit board 51 and power cord 15.

Each housing shell 2 and 3 has a plurality of bracket pairs integrally formed in the interior thereof for receiving and retaining the above-identified components. Each shell has an upper forward bracket pair consisting of brackets 25a and 25b forming a receptacle 25c therebetween. The bracket 25a has a substantially vertical wall 25d and the bracket 25b has a corresponding substantially vertical wall 25e. When the halves 2 and 3

are joined, the vertical walls form an air passage 60 therebetween as shown in Figure 5.

Each housing shell 2 and 3 further has a forward central bracket pair consisting of brackets 26a and 26b forming a receptacle 26c therebetween. As also best seen in Figure 5, air passages 61a and 61b are formed between the upper forward bracket pair and the central forward bracket pair.

Each housing shell 2 and 3 further has a lower forward bracket pair consisting of brackets 27a and 27b, forming a receptacle 27c therebetween. The bracket 27a has a substantially vertical wall 27d and the bracket 27b has a substantially vertical wall 27e. As best seen in Figure 5, an air passage 63 is formed between these vertical walls when the halves 2 and 3 are joined. Additional air passages 62a and 62b are formed between the central forward bracket pair and the lower forward bracket pair, the rear bracket pair 30a and 30b and 31a and 31b are similarly equipped at 66b and 65b.

Each housing shell 2 and 3 has an upper rear bracket pair 28a and 28b forming a receptacle 28c therebetween. The bracket 28a has a generally vertical wall 28d and the bracket 28b has a generally vertical wall 28e which, as best seen in Figure 4, form an air passage 67 when the halves 2 and 3 are joined.

Each housing shell 2 and 3 further has a central rear bracket pair consisting of brackets 30a and 30b forming a receptacle 30c therebetween. Additional air passages 66a and 66b, as best seen in Figure 4, are formed between the upper rear bracket pair and the central rear bracket pair.

Each housing shell 2 and 3 also has a lower rear bracket pair consisting of brackets 31a and 31b forming a receptacle 31c therebetween. The bracket 31a has a generally vertical wall 31d and the bracket 31b has a generally vertical wall 31e which, when the housing halves 2 and 3 are joined, form an air passage 68 therebetween, as best seen in Figure 4. Air passages 65a and 65b, as

best seen in Figure 4, are formed between the central rear bracket pair and the lower rear bracket pair.

The housing shell 3 has a plurality of fastener-receiving bosses 23 for receiving the fasteners 8. The housing shell 2 has a plurality of apertures therein in registry with the bosses 23. Additionally, as shown in Figure 6, several of the brackets have supporting struts extending substantially perpendicularly therefrom for stiffening and strengthening the brackets. The struts have not been numbered for purpose of clarity.

As shown in Figures 3 and 5, and in further detail in Figures 9 and 10, the connector 52 is forced into tight adjacent connection with the shroud 41 by a flange thickener 53 which extends around the periphery of the connector 52. The thickener 53, as shown in detail in Figure 9, is received, for example, between brackets 26a and 26b together with a hook 13e carried on a flange 13d of the metal casing 13 of the heater unit 11. The free end 13f of the hook 13e is slightly bent so as to facilitate insertion of the components between the brackets 26a and 26b by initially slightly spreading the brackets apart. This substantially eliminates vibration during operation, thereby contributing to longer component life and further contributing to quieter operation by minimizing vibration-induced noise and rattling. The mounting details shown in Figure 9 for the brackets 26a and 26b apply as well to all forward bracket pairs shown in Figure 6.

A peripheral rim 42a of the motor mount 42 and a peripheral rim of the shroud 41 is received between the three rearward pairs of brackets in the gun 1, as shown in Figures 3 and 4, and is thus tightly fixed, so as to provide a substantially sealed air communication passage therethrough.

As mentioned above, the rear baffle 7 of the gun 1 has a plurality of air inlet openings 38 therein. As shown in detail in Figure 7, the inlets 38 are formed by a plurality of stepped walls 21 which alternate with

curved walls 40, the inlets 38 being formed therebetween above and below the curved walls 20.

Air flow within the gun 1 directed by a combination of the above identified air passages acting in cooperation with the components disposed in the interior of the gun 1 is indicated by the arrows shown in Figure 3. Air is drawn through the rear inlets 38 by the action of the impeller 40 through a radial opening 43a in the motor mount 42, passes over the vanes of the impeller 40, is collected by the shroud 51 and directed in a uniform stream over the heating coil 44, and exits the gun through the openings 48 in the end cap 46 and the openings 13c in the metal casing 13. Additionally, air is drawn inwardly through the opening 14 in the front of the gun 1 by the action of the impeller 40. This air passes between the exterior of the metal casing 13 of the heater unit 11 and the interior walls of the housing shells 2 and 3, and is thus preheated as it passes over the casing 13. After such preheating, the air is drawn through the passages 60, 61a, 61b, 62a, 62b and 63 shown in Figure 5. The air flows around the exterior of the shroud 41 and then through passages 67, 66a, 66b, 65a, 65b and 68 shown in Figure 4. The air is then drawn through the opening 43a and is mixed with the rear inlet air from the inlets 38 for primary heating by movement over the coil 44. Preheating of a portion of the ambient air not only raises the temperature of the output air without the expenditure of additional input power, thereby resulting in a higher output air temperature per energy unit input, but also reduces the temperature of the plastic housing shells 2 and 3 by drawing heat away therefrom with continuous air movement, resulting in improved operator comfort.

As described above, the entire unit is assembled using a small number of mechanical fasteners; the only mechanical fasteners required are the fasteners 64 for affixing the motor 69 to the motor mount 42, and the fasteners 8 used to hold the housing shells 2 and 3

together. All other components are retained in the gun 1 by press fit.

The concept of reverse air flow from opening 14a both preheats a portion of the air and cools the housing around the heater unit 11. Testing has shown the reverse air flow to provide substantial improvement in performance material of operator protection and cooldown after use if the unit is supported tip up to provide natural convection flow through the unit from opening 38 through opening 14.

An impeller and shroud assembly for the blower device is generally referenced at 101 in Fig. 11. The assembly 101 has a shroud 41 which receives a motor mount 42 by press fit therein. The motor mount 42 has an indexing element in the form of a tab or projection 104 which is received in a complimentary recess 105 in the shroud 41. The shroud 41 tapers in the direction of air flow therethrough to an outlet port 106 which is received in a free end 107 of a channel in a connector 52 for transporting air from the assembly 101 to the remainder of the blower device.

An impeller 40 is disposed within the interior of the shroud 41. The impeller 40 as best seen in Fig. 12, has a plurality of curved radially extending blades 110 thereon, fanning outwardly from a central hub 112. Each blade 110 has an air moving surface 111 integrally formed thereon.

The shroud 41 has a plurality of internal lands 113 which are arranged so as to provide a plurality of spaced, radially extending curved apertures 114, as shown in Fig. 12. The curved apertures 114 assume a curve generally corresponding to the curve of the blades 110 of the impeller 40. As the impeller 40 is rotated, (described in greater detail below) the air moved by the impeller blades 110 will move along a path generally corresponding to the curve of the blades 110. The correspondingly shaped openings 114 thus admit air already moving in a direction corresponding to the shape of the opening, thus providing a substantially uniform flow of air through the outlet port 106.

The impeller 40 is rotated by a motor 69 having a rotor 119 terminating in a shaft 39 received in the hub 112 of the impeller 40. The motor 69 is received in a recess 117 of the motor mount 42 formed by a plurality of radial ribs or struts 43 so as to abut against an annular ring 121 centrally disposed in the motor mount 42. The ring 121 has a central opening 125 for receiving the rotor 119. The motor 69 is fixed in place by suitable fastening means 64, such as machine screws. The motor 69 has electrical leads 123. The ribs 43 are each further strengthened by an enlarged stiffener 124 and are connected to a peripheral ring 42a. A solid web 115 spans the openings between each rib 43. An annular air inlet 43a is formed between the webs 115 and the ring 121.

A heating coil assembly constructed in accordance with the principles of the present invention is generally referenced at 11 in Figure 15. The assembly 11 has an annular support element 52, which may be comprised of plastic, and a hollow cylindrical ceramic sleeve 203 closed at each end by respective ceramic end caps 204 and 205. Each end cap 204 and 205 has a central hub 49 (and 49a) from which a plurality of struts or vanes radially extend so as to define a plurality of annularly disposed openings or vents 206 in the end cap 204, and a like plurality of openings or vents 208 in the end cap 205. The hubs 49 and 49a for each of the end caps 204 and 205, and the vanes radially extending therefrom, extend slightly into the interior of the ceramic sleeve 203 so as to form a shoulder in combination with the outer rim of the caps 204 and 205 so as to provide a ceramic insulating shell or housing in combination with the sleeve 203. A ceramic core 210 is centrally disposed within the interior of the housing formed by the sleeve 203 and the end caps 204 and 205. The core 210 has a helical groove 211 formed thereon which receives a helical spiral heating coil 212. The heating coil 212 is of the type well known to those skilled in the art and may consist, for example, of heavy gauge resistance

wire. The flights of the coil 212 may be further separated and insulated by small projections 213 on the core 210.

As shown in the circuit diagram in Figure 14, the coil 212 has a center tap 218 and two end terminals 215 and 239. The center tap 218 is guided within a radial slot 235 in the core 210 to the end of the core 210, at which point the wire 218 enters an aperture 207 in the end cap 204 and is connected to an exterior wire 217 by a connector 219. One end terminal 215 of the coil 212 is received and retained between two spaced posts 242 formed on the core 210 and is conducted through one of the apertures 206 in the end cap 204, wherein it is connected to another exterior wire 214 by another connector 216. The other end terminal 239 of the coil 212 extends through an axial channel 236 within the core 210, the channel 236 terminating in a radial slot 237 adjacent the end cap 205. The wire 239 is conducted through the channel 236 and the slot 237 for connection to the coil 212. The opposite end of the terminal 239 is conducted through another opening 241 in the end cap 204 wherein it is connected to another exterior wire 220 by means of another connector 238.

The annular support element 52 has a plurality of exterior vanes 52a radially disposed around the periphery thereof for positioning and retaining the support element 52, and the remainder of the assembly connected thereto, in the housing of the blower device in which the heating coil assembly 11 is to be employed. The annular support element 52 further has a centrally dispossed boss 225 from which a plurality of ribs or struts 221 radially extend toward the outer rim thereof. The outer rim has a passage 223 for permitting the exterior wires 214, 217 and 220 to exit for connection to a power source.

A cylindrical spacer 224, which may also be comprised of ceramic material, extends centrally through the annular support element 52 between the boss 225 and the end cap 204. The entire assembly is held together, and the relative positions of the elements fixed, by a retainer 230 in the form of heavy gauge square wire. The retainer 231 is swaged at one end 232 thereof. Each element of the assembly 11 has a centrally disposed square bore for receiving the retainer 231. The end cap 205 has a centrally disposed square bore 230, the core 210 has a centrally disposed square bore 229, the end cap 204 has a centrally disposed square bore 228 and the boss 225 of the annular support element 52 has a centrally disposed square bore 226. The spacer 224 has a centrally disposed bore 227, which may be square or circular, since it is not absolutely necessary to radially restrain the spacer 224. A washer 233 is disposed between the swaged end 232 of the retainer 231 and the end cap 205. The opposite free end of the retainer 231 extends slightly beyond the boss 225 and has a press fit retaining washer 234, such as a Tinnerman nut, forced thereon. The washer 234 has a correspondingly shaped opening 240 therein and is slightly bowed such that once in place the edges of the opening 240 provides sufficient friction against the retainer 231 so as to hold all of the elements together. The elements are thus easily longitudinally fixed in relative position, and the square cross section of the retainer 231 received in the respective square bores simultaneously radially fixes the relative positions of the elements. It will be understood that although the retainer 231 is shown as having a square cross section, any polygonal cross section which prevents radial rotation can be employed, such as a hex, triangle, D-shape, or the like, the bores of the respective components through which the retainer 231 extends being correspondingly shaped.

The entire assembly 11 can thus be easily assembled without the necessity of time-consuming adjustment of the various elements. The coil 212 can be wound on the core 210 and the leads extending therefrom easily inserted appropriately through the end cap 204, after which all elements can be placed in succession on the retainer 231 as shown in the exploded view of Figure 17. The entire assembly can then be appropriately inserted within the blower device in which it is to be used.

CLAIMS:

We claim as our invention:

1. A hand-held hot air gun comprising:

a housing having a front opening; a heating element in said housing; blower means in said housing for directing air through said heating element; and air passage means communicating with said front opening and with said blower means for drawing fresh air into said housing through said front opening over said heating element for pre-heating said fresh air before being blown through said heating element and out of said front opening.

2. A hot air gun as claimed in claim 1 wherein said heating element projects out of and beyond said front opening.

3. A hot air gun as claimed in claim 1 wherein said heating element has an external heat conducting shell.

4. A hot air gun as claimed in claim 3 wherein said external heat conducting shell has a radially extending heat conducting flange disposed in said air passages.

5. A hot air gun as claimed in claim 3 wherein said exterior heat conducting shell is a metal tube.

6. A hot air gun as claimed in claim 5 wherein said metal tube projects out of and beyond said front opening.

7. A hand-held hot air gun as claimed in claim 1 wherein said blower means comprises:

a motor, a shroud, an impeller, and a motor mount in said housing connected to said shroud for centrally mounting said motor and said impeller with respect to said shroud, said motor mount being solely supported and retained by said brackets; and said plurality of brackets additionally being a sole supporting and retaining means for said motor, said shroud, and said heating element in said housing.

8. A hand-held hot air gun as claimed in claim 7 wherein said plurality of brackets include a plurality of rear brackets supporting and retaining said motor mount.

9. A hand-held hot air gun as claimed in claim 1 wherein said housing has a plurality of air inlets disposed at a rear thereof, and at least one air inlet disposed at a front thereof.

10. A hand-held hot air gun as claimed in claim 0 wherein said air inlet disposed at a front of said housing is an annular inlet defined by a circular opening in a front of said housing and said exterior surface of said heating element.

11. A hand-held hot air gun as claimed in claim 1 wherein said plurality of brackets include a plurality of front brackets supporting and retaining said heating element.

12. A hand-held hot air gun as claimed in claim 1 further comprising a motor mount in said housing for said motor, and wherein said plurality of brackets consist of a plurality of front brackets supporting and retaining said heating element and a plurality of rear brackets supporting and retaining said motor mount, and wherein said shroud is press fit between said motor mount and said heating element in sealed relation therewith.

13. A hand-held hot air gun as claimed in claim 1 wherein said plurality of brackets consists of a plurality of bracket pairs, each bracket pair defining a receptacle therebetween.

14. A hand-held hot air gun as claimed in claim 1 wherein said plurality of brackets symmetrically comprises on each interior side of said housing:

a pair of spaced upper forward brackets; a pair of spaced central forward brackets; a pair of spaced lower forward brackets, said pair of central forward brackets being spaced from said pairs of upper and lower forward brackets so as to define air passages therebetween;

a pair of spaced upper rear brackets; a pair of spaced central rear brackets; a pair of spaced lower rear brackets, said pair of central rear brackets being spaced from said upper and lower pairs of rear brackets for defining air passages therebetween; said upper and lower forward pairs of brackets in one of said sides defining upper and lower air passages in cooperation with corresponding upper and lower forward pairs of brackets spaced therefrom in the other of said sides; and said upper and lower rear pairs of brackets in one of said sides defining further upper and lower air passages in cooperation with corresponding upper and lower rear pairs of brackets spaced therefrom in said other of said sides.

15. A hand-held hot air gun as claimed in claim 1 wherein said heating element has a flange, and further comprising a sinusoidal spring substantially in registry with said flange and received in at least one of said brackets in said plurality of brackets with said flange for rigidly retaining said heating element and said shroud and said motor mount connected thereto within said housing.

16. A hand-held hot air gun as claimed in claim 1 wherein said blower means comprises:

a motor; an impeller connected to and rotated by said motor, said impeller having a plurality of radially extending curved vanes each having a curved air moving surface; and a shroud surrounding said impeller having an air outlet communicating with a remainder of said hot air gun downstream of said shroud, said shroud having a plurality of radially disposed curved apertures therein communicating with said air outlet and receiving air moved by said impeller, said apertures being curved substantially the same as said curved veins for providing a uniform, low-turbulent air flow to said remainder of said blower device.

17. A hand-held hot air gun as claimed in claim 16 wherein said impeller further comprises a centrally disposed hub from which said curved vanes radially extend.

18. A hand-held hot air gun as claimed in claim 16 wherein said motor has a drive shaft, and wherein said drive shaft is centrally received in said hub of said impeller.

19. A hand-held hot air gun as claimed in claim 16 further comprising:

a motor mount connected to said shroud and having a centrally disposed means for receiving and retaining said motor for centering said impeller within said shroud.

20. A hand-held hot air gun as claimed in claim 19 wherein said motor mount includes an exterior rim connected to said shroud, a plurality of radial struts extending from said rim and terminating in an interior of said motor mount defining a circular receptacle for said motor, and a plurality of solid webs disposed between said struts.

21. A hand-held hot air gun as claimed in claim 19 further comprising an indexing means carried on said motor mount for radially positioning said motor mount with respect to said shroud.

22. A hand-held hot air gun as claimed in claim 21 wherein said shroud has a radial recess therein, and wherein said indexing means is a radial tab carried on said motor mount and received in said recess.

23. A hand-held hot air gun as claimed in claim 1 wherein said heating element comprises:

a continuous ceramic core; a heating coil helically wound on said core and having a plurality of electrical leads; a continuous hollow ceramic sleeve surrounding said core and coil; a pair of ceramic end caps having a plurality of radial apertures therein disposed at opposite ends of said core and coil forming in combination with said sleeve a ceramic insulating

shell completely surrounding said core and coil, said leads extending through said apertures in one of said end caps; an annular support element disposed adjacent said one of said end caps and receiving said leads; each of said core, said end caps and said annular support element having a centrally disposed polygonal bore therein; and a retainer having a cross section preventing rotation extending through said core, said end caps and said annular support element for simultaneously axially and radially fixing and restraining said core, said end caps and said annular support element.

24. A hand-held hot air gun as claimed in claim 23 wherein each of said end caps comprises:

an outer rim; a centrally disposed hub through which said polygonal bore extends; and a plurality of radially extending vanes connecting said rim and said hub.

25. A hand-held hot air gun as claimed in claim 24 wherein said vanes and said hub have a larger axial dimension then said rim so as to extend into said hollow ceramic sleeve.

26. A hand-held hot air gun as claimed in claim 23 wherein said plurality of electrical leads is three, and wherein said ceramic core has a first radial slot therein for receiving a first of said leads, an axial channel extending along the entire length of said core for receiving a second of said leads, and a pair of spaced posts disposed on an exterior of said core for receiving a third of said leads.

27. A hand-held hot air gun as claimed in claim 26 wherein said ceramic core further includes a second radially extending slot disposed at an opposite end of said core from said first radially extending slot, said channel for said second lead communicating with said second radial slot for bringing said second lead to said exterior of said core.

28. A hand-held hot air gun as claimed in claim 23 wherein said annular support element has a means for connecting said support element to said hot air blower.

29. A hand-held hot air gun as claimed in claim 23 wherein said annular support element comprises:

an exterior rim; a centrally disposed boss through which said square bore extends; and a plurality of radially extending struts connecting said rim and said boss.

30. A hand-held hot air gun as claimed in claim 29 further comprising a spacer disposed in said annular support element between said boss and said one of said end caps, said spacer having a centrally disposed bore through which said retainer extends.

31. A hand-held hot air gun as claimed in claim 30 wherein said spacer is comprised of ceramic material.

32. A hand-held hot air gun as claimed in claim 23 further comprising means disposed at opposite ends of said retainer for restraining axial movement of said retainer.

33. A hand-held hot air gun as claimed in claim 32 wherein said means for restraining axial movement of said retainer include a swaged end of said retainer.

34. A hand-held hot air gun as claimed in claim 32 wherein said means for restraining axial movemen of said retainer includes a press fit retaining washer disposed at one end of said retainer adjacent said annular support element.

FIG.1

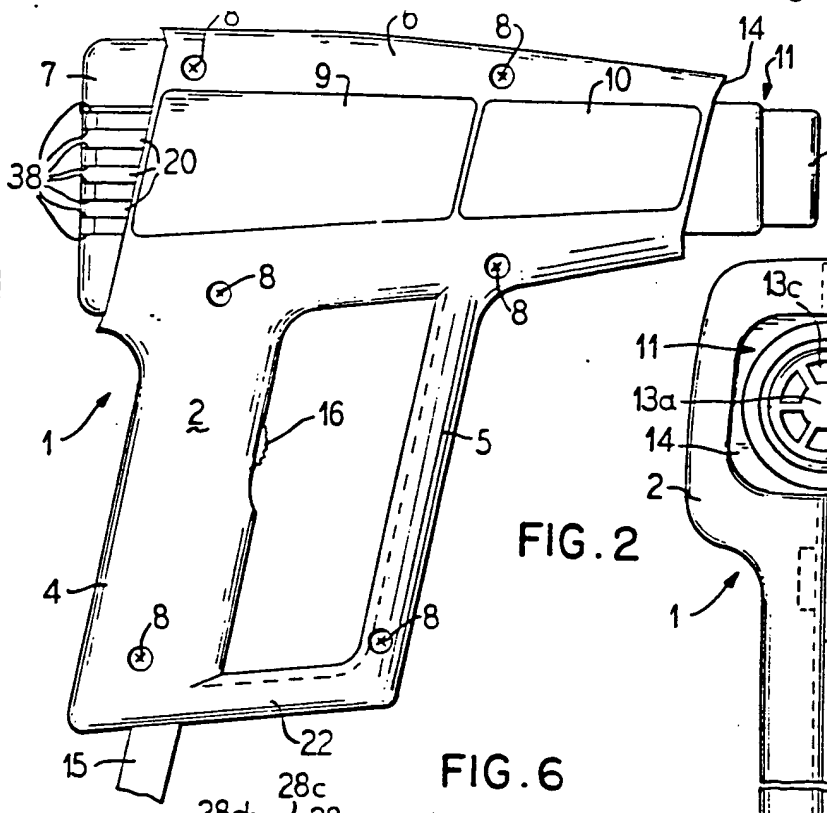


FIG.2

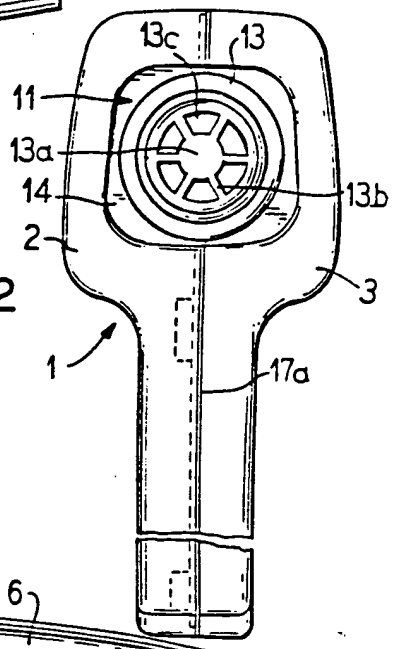


FIG.6

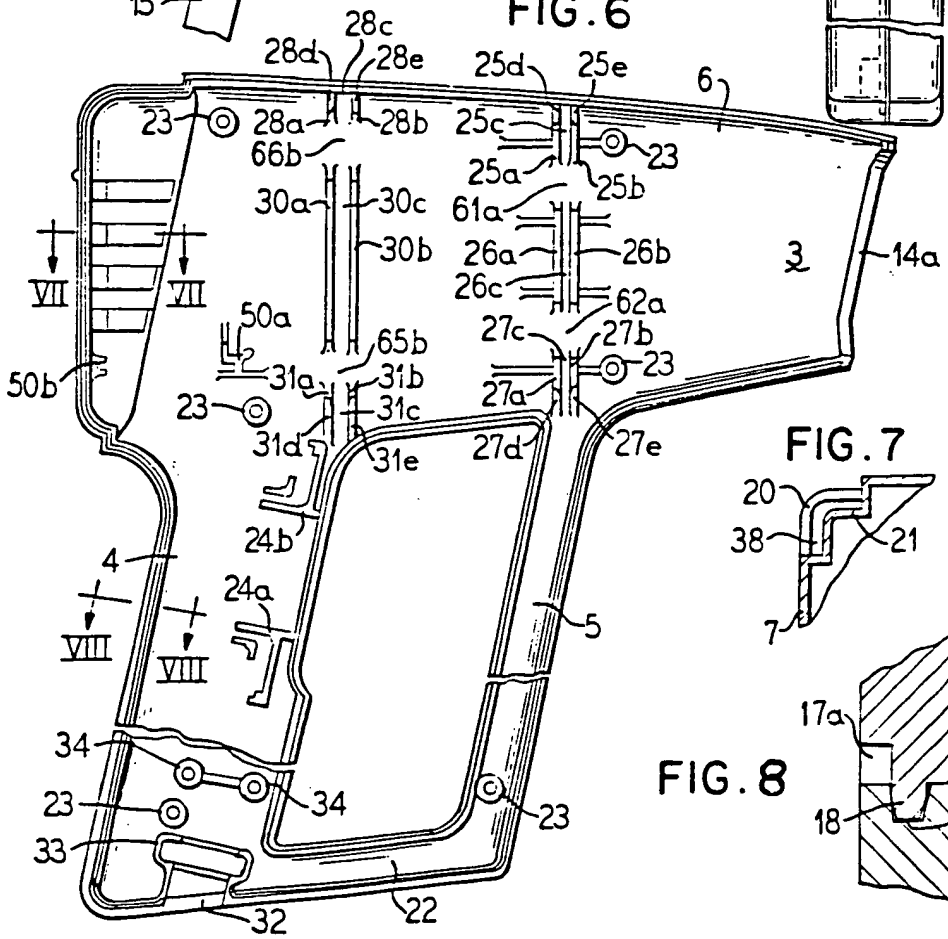


FIG.7

FIG.8

FIG. 3

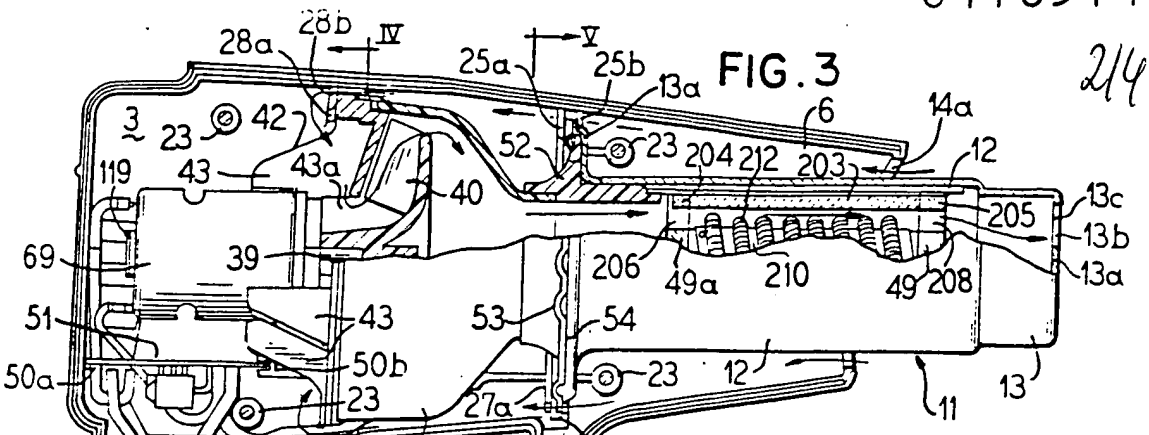


FIG. 4

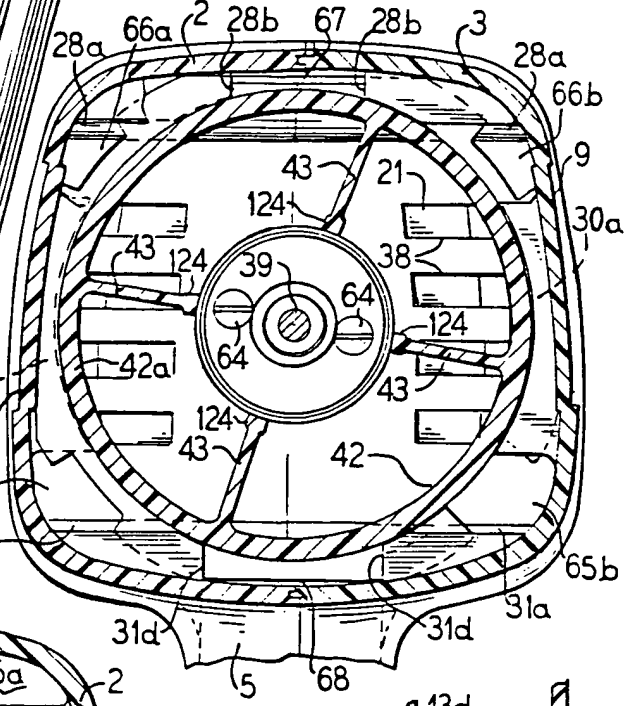


FIG. 5

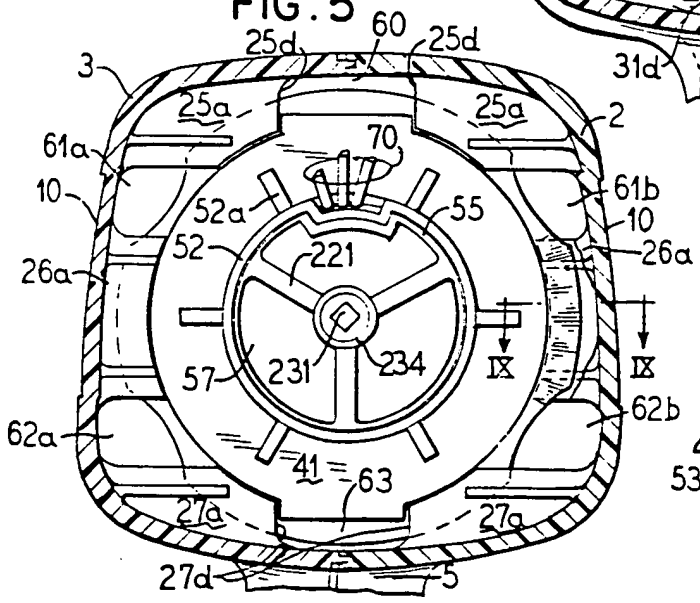


FIG. 9

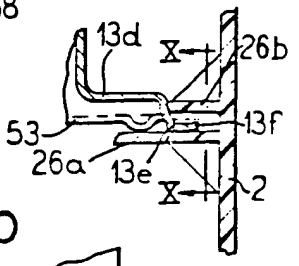


FIG. 10

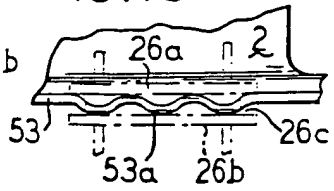


FIG.11

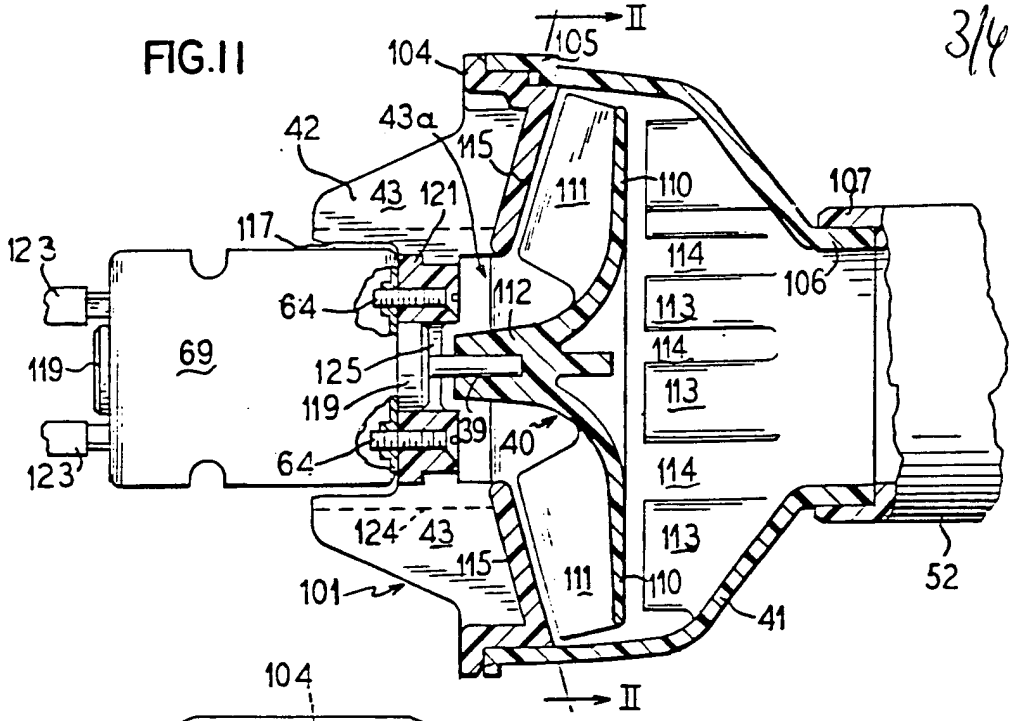


FIG.13

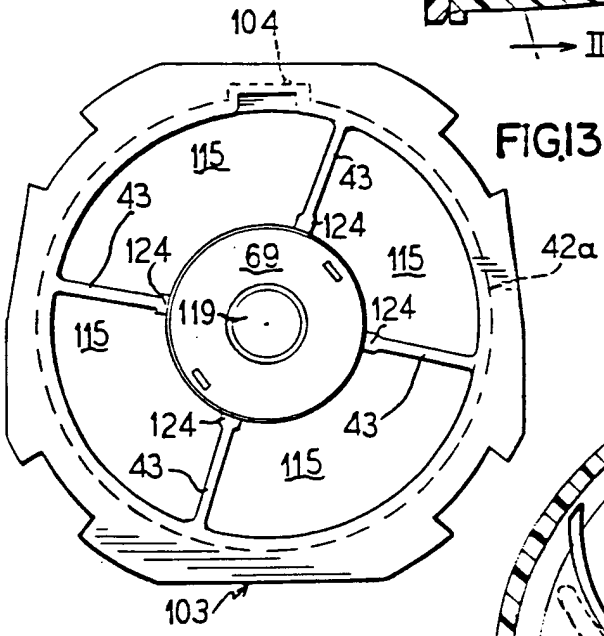
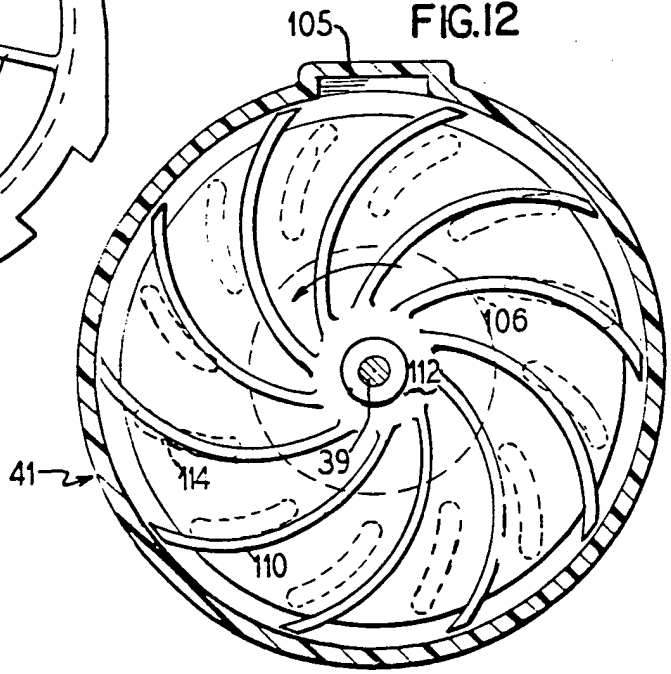


FIG.12



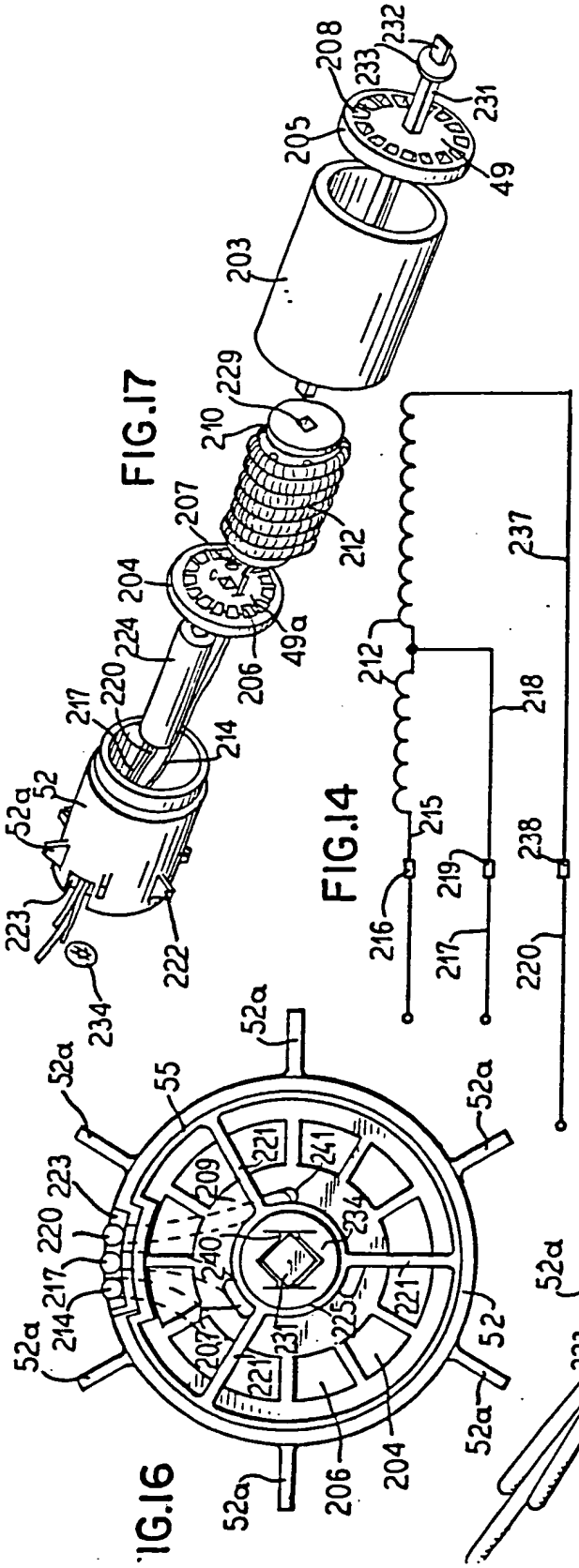


FIG.17

FIG.14

FIG.16

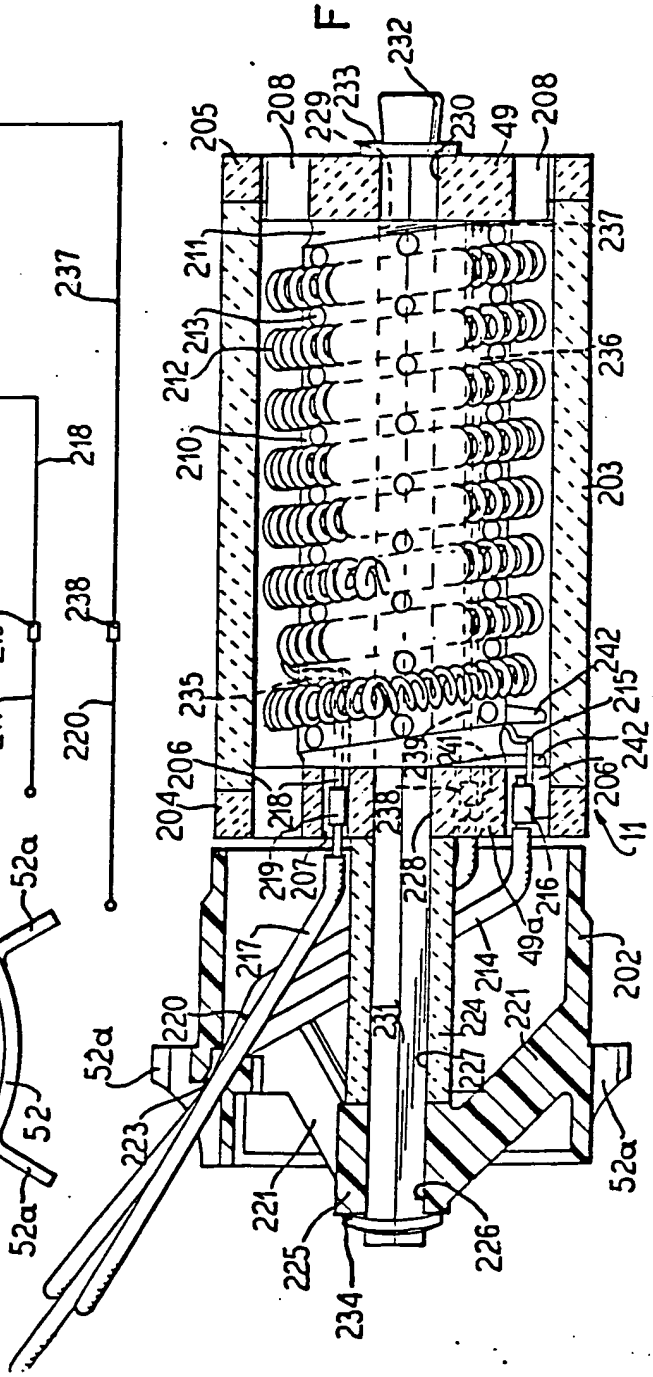


FIG. 15